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AUTHOR Deighton, Lee C.
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ABSTRACT

A book is a presenter of data, an explicator of relationships among the data, an illustrator, and an exerciser. Using the techniques of operations analysis, educators may be able to compare, on a cost-effectiveness basis, various methods of achieving stated objectives. An adequate identification of the values and limitations of the new media does not exist, nor have the goals of instruction been specifically defined. Until these factors are satisfied there will be little motivation for the use of new technological devices in education. (JY)

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Instruments of Instruction: The Book Plus the New Media

by Lee C. Deighton *

After speech and writing, the most important human invention for transmitting knowledge is the book, and it may properly be regarded as the first instance of instructional technology. The book is not determined by its format or the materials of which it is composed. That is, it is not defined as consisting of paper, parchment, or vellum on which text and illustration have been imposed in ink or vegetable dye. The Chinese composed books from thin strips of bamboo on which characters were carved, the strips being tied together at one end.

The idea of the book, the novelty in the invention, is that it is a collection of thin uniformly-sized strips of material, bound together, which can be entered at any point with a relatively simple motion. The ancient scrolls were not books: the scroll had to be unrolled in a series of motions to the points of interest. Later refinements such as the index and table of contents, running heads, and sideheads improved access to the contents of the book.

The textbook as an instrument of instruction is a special kind of book, a modification of the basic invention. The textbook has the following characteristics:

1. It is a presenter of data
2. It is an explicator of relationships among the data. These relationships may be as to time order, cause and effect, likeness and difference, greater or lesser, etc., the basic cognitive structures through which man deals with experience.

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* Lee C. Deighton is Chairman of the Board of The Macmillan Company.

3. It is an illustrator, providing charts, graphs, drawings, photographs to demonstrate data or relationships.
4. It is an exerciser, providing opportunities for use and practice of data and concepts through study questions, tests, exercises and the like. These are the means of interaction between reader and content.

The textbook as an instrument of instruction has certain unique values. It provides an orderly introduction to a discipline or subject matter. It provides ready means of continuous re-view, of comparison, of what Professor Bruner calls "retrogressive Integration." It permits contiguity of text and graphic illustration.

These considerable values and unique characteristics require consideration of the book as one element of instructional technology.

If this proposition is granted, it follows that instructional technology has not suddenly emerged in the second half of the 20th century. The first textbooks in American schools except for the New England Primer were imported from England. Following independence, it became clear to Noah Webster, Jedediah Morse, and others that textbooks of American origin were needed. Textbooks were followed by other technology. At a time when paper was expensive, Joseph Lancaster introduced slates for individual use. Later, blackboards were introduced, and in the interests of art education, the Milton

Bradley Company designed and produced colored chalk. Wall maps and charts were developed. Following on the improvement of photography, the stereopticon was invented for group showings. The stereoscope, for individual use, provided the effect of three-dimensional views. Steel point pens replaced the quill, and eventually pencils and ball-point pens were made available when paper became cheap enough for classroom use. Paper itself for drawing, for exercises, for notebooks was in its time a new element in instructional technology.

There are four aspects of these early instructional instruments that are of special interest today: 1) They were characteristically either for individual use or for group use. Only the textbook could be used in both manners. 2) All of these instruments of instruction permitted in some degree an independence from the teacher's voice which had ruled the classroom for 2000 years. 3) None of these instruments except the textbook met with any substantial opposition. It is recorded that in the 16th century the faculty of the University of Salamanca protested against the printed book as likely to deprive them of a livelihood. The same view is held today by faculties in the colleges of some underdeveloped countries. 4) All of these instruments were adopted to the classroom, having been originally created for use in other contexts.

These four aspects of early technology have a bearing upon the introduction and use of newer forms of instructional technology in our time.

Instructional technology must be considered in the context of a significant non-technologic invention of the mid-20th century: operations analysis. While this analysis was not originally designed for educational purposes, the military have applied it to training and other forms of education with striking success, and it is beginning to find use in the non-military training programs of the federal government. Its usefulness in education is readily apparent. In simplist terms, operational analysis begins with a precise statement of specific objectives and permits a cost-effectiveness comparison of alternative methods of achieving these objectives.

In this framework, study of instructional technology begins with a statement of the objectives of instruction, affective as well as cognitive. The difficulty of defining objectives of instruction is well-known and well-documented elsewhere. The defining question seems to be: What do we want the learner to know, to believe, to feel, to be able to do as a result of a course of instruction?

Assuming that specific answers can be derived in terms of knowing, believing, doing, and so on, the next step in analysis is to consider the alternative means of achieving these objectives. It is at this point that a consideration of the newer means of instructional technology bogs down. Research has not clarified the unique values and capacities of tape recorders, film, television, radio, computers and other media. Until we know the difference between viewing a film and viewing television, we are not in a position to evaluate either.

Beyond this basic inquiry as to the unique values of the various media and devices, there is the question of how best to fit them into the classroom situation, and into the total set of conditions affecting learning what goals of instruction are most effectively sought in a group where everyone meets the same stimuli simultaneously? What goals of instruction are most effectively sought on an individual basis? Even more basically, can an entire course of instruction be presented effectively through a single medium? What happens when an entire course is presented by television, or can it be? What happens when an entire course is presented through programmed materials? Assuming that a combination of media is an effective method, which elements of a course of instruction should be assigned to which media? These are insistent and defining questions for which few answers are available. Without them, the choice of alternatives is a matter of guessing.

For the past 150 years the main concern of American education has been attendance. The major problems of our system today, including finance, arise from the success of the effort to get more students into the schools and colleges. A major effort is now required to discover what to do with the learners now in the schools. The preoccupation of psychologists with general learning theory in the first half of the century was not productive; psychologists are turning now with interesting results to particulars such as

motivation, attention, arousal, anxiety, and to stages of intellectual growth. These are factors of individual learning, but as the Coleman Report dramatically demonstrated, they are not the only conditions of learning. The classroom is an interactive social system within the larger system of the school which is itself part of a community system governed by needs, values, and expectations of persons outside the school system. This is the total mix into which instruments of instructional technology must operate.

The basic questions to ask then are these: 1) What can the new instrumentation do? 2) What can it do in the total context of conditions of learning? 3) What can it do to make instruction more effective, less expensive, and more rewarding to learners and to teachers?

These questions can be made specific to the nature of the media. This paper began with a statement of the unique characteristics and values of the textbook as an instrument of instruction. A similar analysis is wanted for overhead projectors, simulators, computers, film, television and other instruments. The inquiry might begin with two considerations: 1) The textbook is a necessary but not a sufficient instrument of instruction. One cannot learn to speak a foreign language from a book, or to speak at all for that matter. One cannot learn manipulative skills from a book. A process can be described verbally, but it cannot be presented visually in a book. To place upon books the entire burden of instruction leads only to misuse and failure. 2) The newer instruments of instruction primarily

present sight and sound. Learning games provide a different dimension as do computers and industrial machinery, but primarily television, radio, film, transparencies and similar media operate through more or less dramatically heightened light and sound. This factor determines their unique values but also limits their range of effectiveness since heightened light and sound may be distractive.

It is a basic assumption of this report that we do not yet know enough about the values and the effects of the newer instruments of instructional technology to make a pursuasive case for them. We do know that they are in plentiful supply but not in wide use. We do know that their introduction to the classroom has been met with skepticism and resistance.

It would be easy to conclude that educators generally and teachers particularly oppose innovations. To anyone acquainted with the changes in our schools since 1900, this conclusion is inacceptible. It is time to consider the alternative: that the technology and it advocates are at fault. Perhaps the programmed materials really are boring. Perhaps the learner does not react well to the monochrome of an infinitely patient teacher. Perhaps the films are not available at the appropriate moment; perhaps the content is irrelevant and poorly prepared. Perhaps the opportunities for interaction between learner and technology have not been sufficiently exploited.

The original motivation for introducing technologic instruments of instruction was a projected shortage of teachers: the machines would take the places of the missing teachers. The shortage has not occurred, but the image of technology as replacing the teacher has persisted. A different kind of motivation is required. In the military, the use of instructional technology to meet carefully defined objectives has substantially reduced the timerequired for instruction. In the military context, the saving of time and the consequent saving of money are of prime importance. In the schools, with the length of terms prescribed by law, time saving is irrelevant. A wholly different motivation is required, a motivation that would entail redefinition of objectives. It may well be that the failure of instructional technology in the schools and colleges results simply from over-tooling, from the use of powertools in handcraft operations.

Crowell, Collier and Macmillan with which I am associated has produced tapes, films, filmstrips, phonograph records, overhead transparencies, and programmed materials - all of the materials of the newer technology except computer programs and machinery. This is the record of all the leading publishers of instructional materials. These materials have one common characteristic: they are conceived and designed as parts of a course of instruction with a textbook at its center.

There is one publishing trend that could make a substantial difference in the successful use of technology, particularly of

computer-managed instruction. This is the trend to produce shorter units of printed materials bound separately rather than as a single large book. If adequate storage and transfer facilities are provided in the schools, teachers will be encouraged to use them for individual and small group instruction.

Summary: The extension of instructional technology will depend upon the following:

1) Identification of the peculiar values and limitations of media and devices including the textbook.
2) Identification of more specific goals of instruction in the manner of operations analysis.
3) A new motivation for use of technologic devices based upon the reality of what they can contribute and how they can be used.

Instructional technology is not a unique discovery of the mid-20th century. The aura with which they have been vested by enthusiasts tends to obscure their real values and real limitations. We have tried without success the stratagy of dumping $350 millions of materials into the schools through NDEA. Perhaps its is time to try a slower, more rational strategy.

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